KIBABII UNIVERSITY

UNIVERSITY EXAMINATIONS

2022/2023 ACADEMIC YEAR

SECOND YEAR FIRST SEMISTER EXAMINATION

FOR THE DEGREE

OF

BACHELOR OF SCIENCE (CHEMISTRY)

COURSE CODE: SCH 211./214*

COURSE TITLE: ATOMIC STRUCTURE AND CHEMICAL BONDING

INSTRUCTION: ANSWER **ALL** QUESTIONS

DATE: 20/12/2022 **TIME: 2:00-4:00PM**

This paper contains 4 printed pages

(MAIN EXAM)

Plank's constant, $h = 6.626 \times 10^{-34}$ Js

Speed of light(in vacuum), $c = 2.998 \times 10^{8} ms^{-1}$

Rydberg's constant, $R_H = 1.0968 \times 10^{7} m^{-1}$

Mass of electron, $m_e = 9.11 \times 10^{-31} kg$

$1A = 10^{-10} m$ and $1J = 1\ kgm^2s^{-2}$

Electronic charge, $e = 1.602 \times 10^{-19} C$

Permittivity, $\varepsilon_0 = 8.854188 \times 10^{-12}\ C^2/Jm$

QUESTION ONE (30MARKS)

a) Discuss the Rutherfold atomic model **(3mks)**

b) Explain the Bohr's model of the atom citing its limitations **(4mks)**

c) Calculate the energy of an electron transition from n=4 in the Balmer series for the hydrogen atom predict its colour on spectrum line **(2mks)**

e) i) For a particle in a one dimension box, $E_n = \frac{n^2h^2}{8ma^2}$, m=mass of particle

Calculate the energy difference between n=2 and n=4 levels for an electron confined to a one dimension box having length $1x10^{-10}$m in joules **(4mks)**

ii) Given that $\Psi = A \sin\left(\frac{n\pi}{a}\right)x$. Sketch the plots for Ψ and Ψ^2 for n=2 for transitions in the box **(4mks)**

g) i) Briefly discuss malleability in copper metal **(4mks)**

ii) Why do metals shine when exposed to light **(2mks)**

h) State aufbau principles in filling electrons in multielectron atoms **(3mks)**

i) What is the difference between a covalent and dative bond. **(2mks)**

j) Briefly explain the relationship between screening effects and penetrating effects **(2mks)**

QUESTION TWO (20 MARKS)

a) Discuss the following terms

i) electronegativity and

ii) electron affinity **(4mks)**

b) Explain why $SiCl_4$ has a lower melting point than SiO_2 (Si= 28, Cl=35.5, O=16) **(4mks)**

c) Use CHCH to differentiate between pi (π) and sigma (δ) covalent bonds **(4mks)**

d) Draw and identify intramolecular and intermolecular hydrogen bonds on nitrophenol molecule **(4mks)**

e) Explain the trend in lattice energy down group 2 oxides **(4mks)**

QUESTION THREE (20 MARKS)

a) Calculate the effective nuclear charge(Z_{eff}) for a 3d electron in iron (III) ion (Fe=26) **(5mks)**

d) Account for the molecular shape of NH_3 using the VSEPR **(4mks)**

e) Give 3 limitations of the valence bond theory **(3mks)**

f) Describe the delocalization on benzene molecule, C_6H_6 **(4mks)**

g) Draw the resonance structure for CO_3^{2-} **(4mks)**

QUESTION FOUR (20 MARKS)

a) Explain why sodium chloride is not reactive whereas both its elements sodium and chlorine are very reactive **(5mks)**

b) State 3 characteristics of an ionic compound **(3mks)**

c) i) what is polarization **(3mks)**

ii) Explain why KI(s) has a higher melting point than LiI **(4mks)**

d) A radioactive material emits photons, each having energy of 1.6×10^{-13}J. Calculate the frequency and wavelength of the electromagnetic radiation emitted by the radioactive material **(5 mks)**

QUESTION 5 (20 MARKS)

a) i) Use the allowed combination (n,l,m) to draw the orbitals in the outermost energy subshell in the table below. **(5mks)**

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n	L	m	Orbital type
3	2	-2	
3	2	-1	
3	2	0	
3	2	1	
3	2	2	

ii) Sketch the p-orbitals **(3mks)**

b) State two limitations to the octet rule **(3mks)**

c) Explain why the first ionization energy of B is 801KJ/mole while the one of Be is 899Kj/mole **(4mks)**

d) Draw the homonuclear correlation diagram for boron and determine its magnetism **(5mks)**